



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/767,764	01/29/2004	Max F. Hineman	2269-5925US (03-0290.00/U)	5543
24247	7590	02/27/2007	EXAMINER	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			QUINTO, KEVIN V	
			ART UNIT	PAPER NUMBER
			2826	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/27/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/767,764

Applicant(s)

HINEMAN ET AL.

Examiner

Kevin Quinto

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 January 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

1. The amendment under 37 CFR § 1.116 dated January 30, 2007 has been entered.
2. In the below Office action, the examiner has rejected claims 1-16, 20, 22, and 24-25 under 35 U.S.C. 102(b) as being anticipated by Aoki et al. (USPN 6,465,352 B1) and claims 17, 18, 19, 21, and 23 have been rejected under 35 U.S.C. 103 as being unpatentable over Aoki (claims 17, 18, and 19) as well as in view of Yamasaki et al. (United States Patent Application Publication No. US 2001/0034127 A1 – claim 21) and Andrews et al. (USPN 6,270,353 B1 – claim 23). In the arguments (filed October 5, 2005) concerning figures 7A-7F of the Aoki reference (USPN 6,465,352 B1), the applicant asserts that Aoki prevents the oxidation of the copper film (p. 10 of the response) and does not expose the copper to oxidation injury (p. 11). However it is clear that the copper film of Aoki does experience oxidation injury. Aoki discloses, in figure 9, that the copper does experience oxidation injury. Therefore claims 1-16, 20, 22, and 24-25 are anticipated by figures 7A-7F of Aoki and claims 17, 18, 19, 21, and 23 have been rejected under 35 U.S.C. 103 as being unpatentable over Aoki (claims 17, 18, and 19) as well as in view of Yamasaki et al. (United States Patent Application Publication No. US 2001/0034127 A1 – claim 21) and Andrews et al. (USPN 6,270,353 B1 – claim 23).

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-16, 20, 22, 24, and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by Aoki et al. (USPN 6,465,352 B1).

5. In reference to claim 1, by Aoki et al. (USPN 6,465,352 B1, hereinafter referred to as the "Aoki" reference) discloses a similar method. Figures 7A-7F of Aoki illustrates a method for forming a damascene structure which meets claims 1. A damascene opening is formed to expose a metallic layer (3) in a damascene structure. The metallic layer (3) is exposed to a reducing plasma to at least partly reverse an oxidation injury (column 6, lines 46-67) to the metallic layer (3). A cleaning process is applied to the damascene structure (column 9, lines 34-48). A metallic plug (22) is formed in the damascene opening such that it is in electrical connection with the metallic layer (3).

6. With regard to claims 2, 3, and 4, the metallic layer (3) is formed of copper (column 8, lines 57-60), a metal which the applicant has characterized as having an easily reducible oxide (p.10, paragraph 45 of applicant's current specification).

7. In reference to claim 5, hydrogen plasma is used as the reducing plasma (column 6, lines 46-67).

8. With regard to claims 6 and 7, the hydrogen plasma includes nitrogen as an inert gas (column 9, lines 16-29).

Art Unit: 2826

9. In reference to claims 8 and 9, Aoki meets these limitations (column 6, lines 46-67).

10. With regard to claims 10, 11, and 12, it is understood that the process of figures 7A-7F may be implemented for a dual or triple damascene structure. Furthermore figures 7A-7F show damascene structures which include a plurality of damascene levels.

11. In reference to claims 13, 14, and 15, figures 7A-7F makes it clear that the reducing plasma process and the formation of the damascene opening occur in the same environment or chamber (column 8, lines 51-67; column 9, lines 1-57). The chamber is a substantially vacuum environment (column 9, lines 21-29).

12. With regard to claim 16, Aoki discloses that forming the damascene opening and exposing the metallic layer to the reducing plasma are carried out in an environment having less oxygen than ambient air (column 9, lines 21-29).

13. With regard to claim 20, a diffusion barrier (20) is formed over the damascene structure before forming the metallic plug (22).

14. In reference to claim 22, Aoki discloses the use of a wet cleaning process (column 9, lines 34-38).

15. With regard to claims 24 and 25, the metallic plug (22) uses copper (column 9, lines 49-55), which is the same material as the metallic layer (3).

Claim Rejections - 35 USC § 103

Art Unit: 2826

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

17. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1).

18. In reference to claims 17 and 18, Aoki discloses that the plasma process occurs for a duration of 30 seconds to 10 minutes (column 7, lines 35-38). The applicant has claimed ranges of "about 10 to about 60 seconds" and "about 10 to about 30 seconds."

However the examiner would like to note:

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP 2144.05.

Thus claims 17 and 18 do not distinguish over the prior art reference of Aoki.

19. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1).

20. In reference to claim 19, Aoki discloses that the reducing plasma is provided at a pressure of 0.1 Torr to 1 Torr which is 100 milliTorr to 1000 milliTorr (column 7, lines 32-34). The applicant has claimed a pressure of "about 100 milliTorr." However the examiner would like to note:

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP 2144.05.

Thus claim 19 does not distinguish over the prior art reference of Aoki.

Art Unit: 2826

21. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1) in view of Yamasaki et al. (United States Patent Application Publication No. US 2001/0034127 A1).

22. With regard to claim 21, Aoki does not disclose the use of a tungsten nitride diffusion barrier. However the use of a tungsten nitride diffusion barrier is well known in the art. Yamasaki et al. (United States Patent Application Publication No. US 2001/0034127 A1, hereinafter referred to as the "Yamasaki" reference) discloses that tungsten nitride diffusion barriers have the benefit of good step coverage which is desired in the art (p.1, paragraph 12). In view of Yamasaki, it would therefore be obvious to use tungsten nitride as the diffusion barrier in the Aoki device.

23. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (USPN 6,465,352 B1) in view of Andrews et al. (USPN 6,270,353 B1).

24. With regard to claim 23, Aoki does not disclose the use of an aqueous dilute hydrofluoric acid for the wet cleaning process. However the use of an aqueous dilute hydrofluoric acid in a wet cleaning process is well known in the art. Andrews et al. (USPN 6,270,353 B1, hereinafter referred to as the "Andrews" reference) discloses that a hydrofluoric acid wet etch process has the advantage of being a quick and low cost process (column 4, lines 6-9). In view of the benefits disclosed by Andrews, it would therefore be obvious to use an aqueous dilute hydrofluoric acid for the wet cleaning process in the method of Aoki.

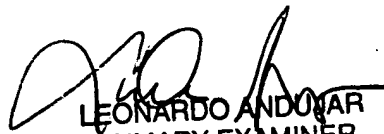
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Quinto whose telephone number is (571) 272-1920. The examiner can normally be reached on M-F 8AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571) 272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

KVQ


LEONARDO ANDUJAR
PRIMARY EXAMINER